BIG STORMS—BIG FLOODS

Records of storms date back to very ancient times. Until relatively recently, descriptions of storms dealt principally with the terror and havoc they wrought, infrequently with causative meteorological phenomena. Old accounts told of men, trees and livestock felled, fields awash, buildings demolished and bridges swept away. This assessment of property loss is still the common criterion for computing storm values. Having acquired more sophisticated concepts and instruments, we have renounced much of the awe which our ancestors held for the elemental forces of wind, rain and flood. Gages, tracking devices and instant communications systems have given us an edge on the old-timers, but when the winds have abated and the water receded, we go back as they did, tote up our losses and build again in the same place.

Many of us live and work in flood plains in which the flood frequency may range between two and 1,000 years. We return home, and home for many is located in long-established areas, settled centuries ago by agrarian forebears who staked their claims on fertile lands near navigable streams. The periodic devastation of floods becomes an accepted, calculated risk; like parking in a restricted zone, one takes the risk and if caught, one pays the fine. Simple logic suggests the impossibility of forestalling every danger; though we were to establish our habitations on the summits of a thousand Ararats, yet would there be that chance that a millenial flood, sweeping all before it, would come to mock our vain preparations.

It is unlikely that recent storms were more frequent or of greater magnitude than those of the past. Damages to property and loss of life due to storms have greatly increased because of the greater numbers of people and vulnerable properties occupying the flood plains. While warning systems have been effective in removing populations from the path of onslaughts of wind and rain, precautionary advice concerning the perils of flood plain habitation goes generally unheeded. Inhabitants of river towns keep records of the extreme stages of recurrent inundations marked on their surviving walls and accept the unalterable periodicity of storms and floods; losses in the money column are a fraction of the total damage; the floods bring temporary discomfort—of nuisance value—but relocation is rarely contemplated. In areas without histories of flood frequency, the survivors of an occasional washout return to the old site, humanly confident that lightning, snakes and floods do not strike twice in the same place.

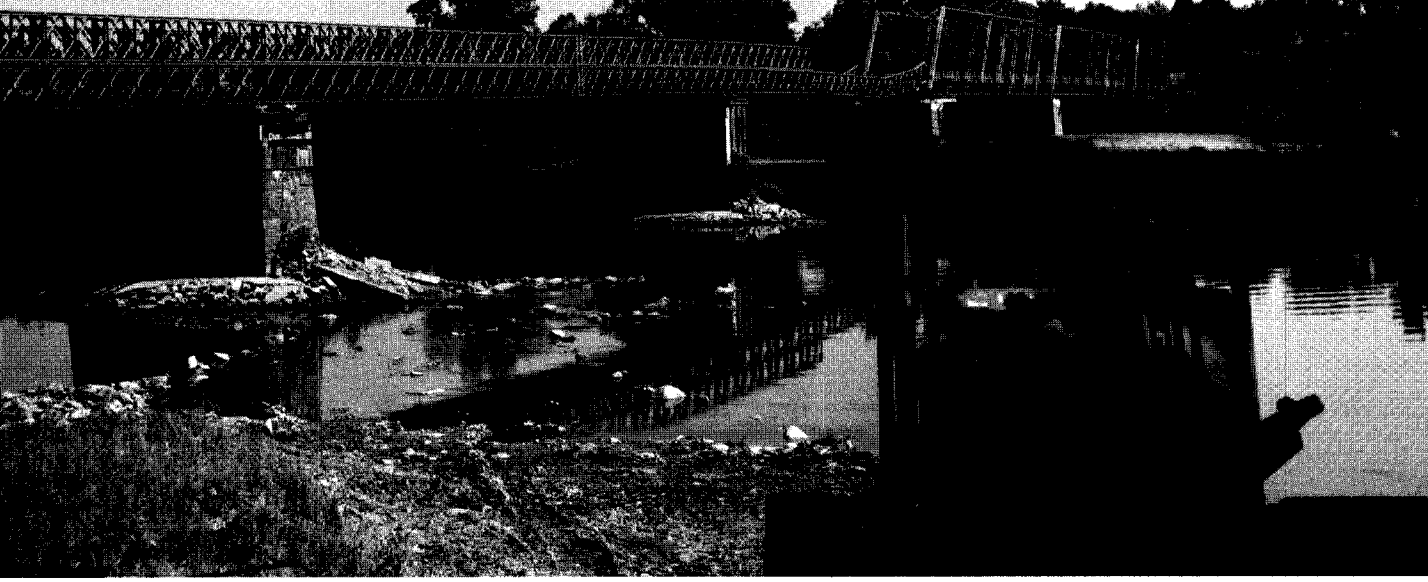
Students of river basin regimen know that floods do recur and may occur almost anywhere with an appropriate combination of conditions. Effective measures to alleviate flood damage have been taken and more are planned by continuing programs of the Federal Government. Familiar to all are the great public works, the dikes, dams and reservoirs which constitute the protective features of the flood control projects; less familiar but equally important is the preventive Flood Plain Management Program. This program seeks to resolve the flood risk problems of vulnerable zones right down to the home-site level; obviously, the amount of local cooperation required for success makes it preponderantly a citizen participation effort.

Waters of the Lehigh River in the streets of Bethlehem, Pa. Flood of May, 1942.

The Flood Plain Information Studies Program was conceived originally as a technical guide for States and municipalities in regulating the uses of flood plains by: identifying specific susceptible areas, establishing general criteria for regulation; and providing engineering advice upon request to responsible State and governmental agencies, subject to approval by the Chief of Engineers. Authority for the studies was contained in the Rivers and Harbors Act of 1960 under Section 206 of Public Law 86-645. Numerous agencies in the District area, duly organized as local Planning Commissions, have availed themselves of the program. Brochures are prepared by the District's Flood Plain Management group and printed copies made available to local requesting agencies. The specific area under study is presented in maps, photographs, formulae, flood profiles and cross sections, together with a brief history of the area and of local floods. A condensed version of the study is supplied in leaflet format. The studies provide estimates of the flood potential of area streams, defined by type and frequency of flood, and offer technical assistance in interpreting the data contained in the reports.

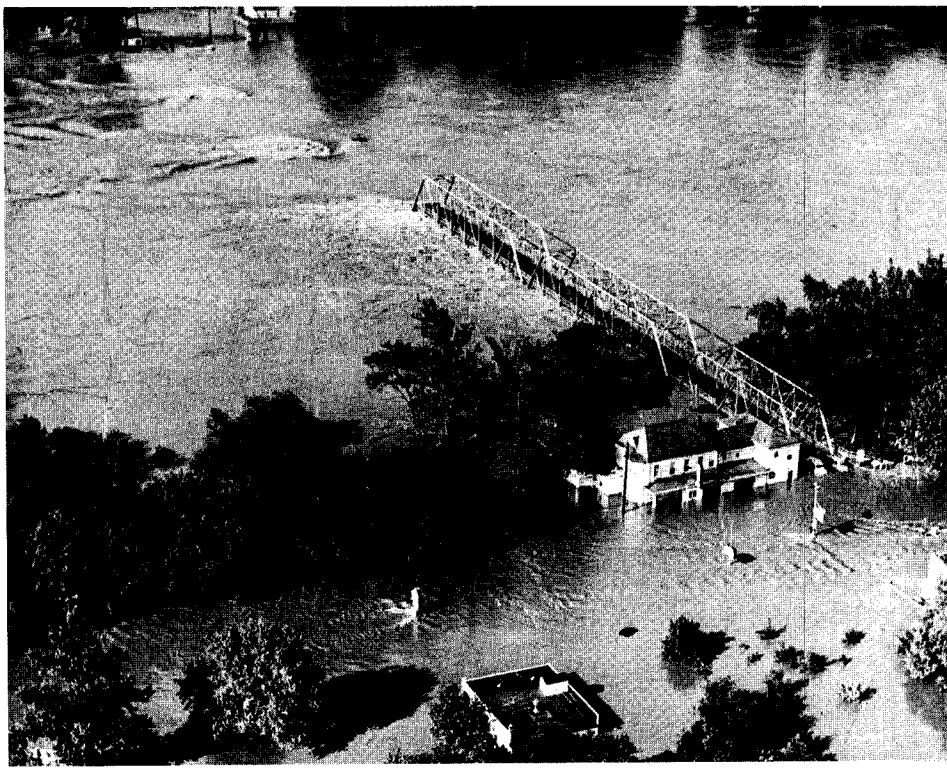
The term "Flood Control" has often been misinterpreted, it being assumed by many that Corps of Engineers Programs so designated assure complete control, with permanent protection under all conditions. "Flood protection" more accurately characterizes the design of the control systems now in operation or planning. The existence, in 1942, of the eleven major dams projected for the Delaware Basin would have prevented much of the damage inflicted by one great storm. For three weeks in May 1942, heavy rains overcharged the basin's watercourses to flood stage: on the Schuylkill River at Reading, the third highest since 1757; on the Lehigh River, the second highest in 156 years of record; and on the Lackawaxen River, the highest of any recollection. Property losses amounted to $15,000,000, 33 persons died and 35 bridges and ten small dams were destroyed. Four of the eleven dams of the Comprehensive Basin Plan are now operational: Walter Dam on Lehigh River, Prompton Dam on Lackawaxen River, Jadwin Dam on Dyberry Creek (a tributary of the Lackawaxen), and Beltzville Dam on Pohopoco Creek (a Lehigh River tributary).

The memorable floods of January 1841 on the Delaware, Lehigh and Schuylkill Rivers brought ice, rain and snow surging destructively down the valleys; in October 1869, after a summer drought, torrential rains overtopped the banks of the Delaware and Schuylkill Rivers and "swept houses and barns and even men down the furious element." The canals suffered heavily; their ditches, paralleling or penetrating the streams, were highly vulnerable, their ashlar locks and earthen banks no match for the swirling flood. With a characteristically casual



Two-lane Bailey Bridge constructed on piers of destroyed Yardley span.

Stoicism, the canallers returned and patched up their works, continuing their struggle to wrestle profits from adversary elements. Casual, too, was the succession of events which culminated in the nation's worst dam break disaster. On 31 May 1889 the South Fork Dam discharged its contents down Little Conemaugh Valley, sweeping everything before a 40-foot wall of water to Johnstown, Pennsylvania, 15 miles below. South Fork Dam was a 70-foot high earth-fill structure, built in 1852 to impound water for the Pennsylvania Canal. Upon abandonment of the canal in 1857, the obsolete reservoir was allowed to deteriorate. It was purchased by private interests in 1879 and modified for use as an exclusive sportsman's resort. Modifications included closure of the discharge pipes; construction of a roadway across the embankment, reducing the freeboard by two feet; and



Delaware River at Yardley Bridge, flood of August 1955 (Operation Noah)

installation of fish guards and trestle supports in the spillway. The obstructed spillway lacked an adequate discharge capacity; two days of concentrated rainfall in May 1889 gorged the upland feeders; the dam was overtopped and collapsed. Lower Johnstown was virtually obliterated and more than 2,100 persons died.

Intelligent application of flood plain zoning can be an extremely effective way to preventing costly damage in the aftermath of heavy rains and stream overflow. Seashore areas require special preventive measures to counter their unique storm problems. The difficulty of applying such measures emanates particularly from the areas' unusual economies; sand beaches and contiguous shore-front real estate are the major commercial resources; the construction of protective dunes or seawalls could forfeit the economic benefits of a unique natural asset. Extreme precipitation with stream overflow is not a typical flood problem at the District's ocean front areas; the severest, most damaging storm of record on the New Jersey and Delaware coasts was accompanied by an insignificant amount of precipitation.

The "Five-High" storm which pounded the Atlantic Coast from the sixth to the eighth of March 1962 was classified by the U. S. Weather Bureau as an "extratropical cyclone, unusual in composition and behavior." The

Major breach at Harvey Cedars. "Five-High" storm.

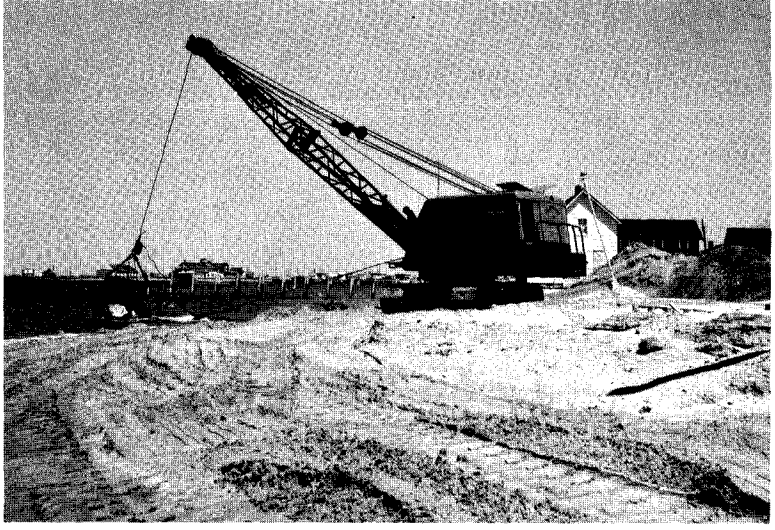
Inundated West Wildwood in foreground, looking northeast. "Five-High" storm.

already high tides, augmented by high winds, slammed giant waves and breakers into shorefront facilities from New England to Florida. This storm, with five successive record-high tides, wrought destruction to 65 million dollars worth of beaches and shore facilities and damaged homes, automobiles and utilities for an additional loss of 169 million dollars. More than 70,500 dwellings were damaged or destroyed; 28 lives were lost. The States hit hardest were declared to be "disaster areas" by the President: New Jersey, Delaware, Maryland and Virginia, on March ninth; New York and North Carolina, on the sixteenth.

The impact of "Five-High" was as unexpected as it was unusual: continuous successive low pressure systems, spread over the whole North Atlantic with no well-defined center, made it difficult to plot the storm's path of development. However, early portents seemed to signal potential disaster and emergency groups began relief mobilization before the storm was one day old. A Presidential Disaster Declaration set in motion the official relief and rehabilitation agencies of the Federal Government and "Operation Five-High" went into full swing. The Office of Emergency Planning established regional disaster headquarters at New York City; Trenton, New Jersey; Dover, Delaware; Pikesville, Maryland; and, Richmond, Virginia.

84th Street and Beach, Stone Harbor, N.J. "Five-High" storm.

The Corps of Engineers was assigned the responsibility for organizing, planning and carrying out emergency restoration of coastal damage. The District's Disaster Control Center, with responsibility for the New Jersey coast south of Manasquan Inlet and the entire shore line of the State of Delaware, deployed its units to cover the stricken region. Field parties made damage estimates and recorded relevant data. A master plan for rehabilitating the affected areas evolved through close liaison between District, Division and Regional Group disaster control centers. Contractors were on the job at daybreak of March tenth closing breaches in the barrier island at Harvey Cedars, New Jersey. Heavy equipment was at work on the fifteenth closing critical gaps in barrier beaches above Indian River Inlet, Delaware.



Dragline moving sand at Harvey Cedars. "Five-High" storm.

But little could be done until the storm had subsided; the unrelenting three-day assault allowed no time to recoup between tides, so that each tide compounded the damage of its predecessor. Up and down the Atlantic coast, 11,800,000 cubic yards of sand were hauled or pumped into 85 miles of emergency dunes and beaches; 8,600 feet of bulkhead were constructed and 35 miles of sand fence erected. To this must be added the considerable operations of removing ruined houses and cleaning up debris. By August 1962, most of the emergency work by the Corps of Engineers was complete. Costs of rehabilitation operations were met by Office of Emergency Planning funds authorized under Public Law 875, 81st Congress, except for the cirtical first contracts funded out of appropriations authorized for the maintenance of navigation channels.

A "Great Storm" can be many things: that storm which eventuates in a downstream urban cataclysm may have delivered only providential irrigation to upland acreage. The accumulated fury of a storm is essentially measurable, its generative forces discernible, its path and peak predictable. Rainfall, runoff and stream flow are constantly being gaged to fill in that myriad of detail which defines the land's behavior patterns. The analysis of acquired data gives a base for formulating plausible protective measures and for anticipating the probability of flood recurrence. Conditions of minimal flood risk are achievable through intelligent application of existing guidelines; locally-regulated flood plain zoning should be as essential to community planning as fire prevention and pollution control.

It is ultimately as unrealistic to expect absolute flood protection as it is foolhardy to scorn those protective measures which may be utilized. Safety factors are built into the control structures erected by the Corps in the District and throughout the world. United States Geological Survey records reveal with sobering consistency the recurrence of large storms and floods across the country since 1543; the cyclic cataclysms of our most ancient legends were often imaged as diluvian downpourings followed by universal inundation. Most certainly floods will come; some probably will exceed the greatest now on record. To design control systems for the greatest of all possible floods would entail contemplating a total revision of the American life style and a financial outlay of unimaginable proportions.

From January to December, 1892 was a flood year throughout the United States. Ohio, particularly Dayton, remembers 1913, for days and nights of terror when fire and flood led to the loss of 467 lives. Mississippi River floods made headlines in the spring of 1927 and focused the attention of the federal government on national flood problems. In 1936, storms and floods were widespread in the land; Pennsylvania was especially stricken and the Congress of the United States passed the first general Flood Control Act. The Delaware Valley became a disaster area again in 1955, following the one-two punch of tropical hurricanes "Diane" and "Connie;" Federal, state and private agencies collabo-

Destroyer-escort Munson beached at Holgate, N.J. "Five-High" storm.

rated with the District's Valley Report Group in a comprehensive water resources survey on a basin-wide scope.

The first main stem control project for the District is in the advanced planning stage. When completed, Tocks Island Dam and Reservoir on the Delaware will function as an important element of the basin's flood protection system. Its essential mandate is husbandry of the indispensable life ingredient: water for human consumption. The voracious demands of population and industry constantly threaten to overtake the limited supply. Every move creates a measure of ecological imbalance; to General F. P. Koisch[1]:

> *". . . we're concerned, but people don't know enough about it to give good advice. You have to stand still and study life cycles, and we don't have time. We have to develop before 1980 as much water resource development as has taken place in the whole history of the nation."*

Man's mode of living runs counter to nature's economy. The life apparatus with which he has surrounded himself and upon which he has become dependent exacts a constant drain on the earth's resources and returns little. We must recognize the need to halt and reverse what is wasteful in the accepted regimen. Water resource management increases in importance with the escalating demands of proliferating industry and an exploding population. With little prospect for reversing consumption, it is doubly urgent that efforts to increase the water supply be pursued, employing the best available expertise in engineering and biology.

Flood of August 1955. Confluence of Lehigh and Delaware Rivers at Easton, Pa. and Phillipsburg, N.J.